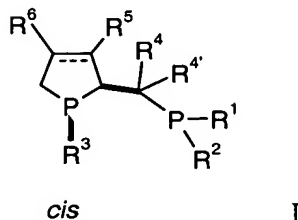


## Claims

1. A phosphine compound of the formula I



wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is an optional double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I.

2. The compound of formula I according to claim 1 wherein

$R^1$  and  $R^2$  are the same and are alkyl, aryl, cycloalkyl or heteroaryl, said alkyl, aryl, cycloalkyl or heteroaryl may be substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl or aryl;

R<sup>4'</sup> and R<sup>4</sup> are hydrogen;  
R<sup>5</sup> and R<sup>6</sup> are independently of each other hydrogen, C<sub>1</sub>-C<sub>3</sub>-alkyl or phenyl;  
the dotted line is absent;  
R<sup>7</sup> is alkyl, aryl or NR<sup>8</sup>R<sup>8'</sup>; and  
R<sup>8</sup> and R<sup>8'</sup> are independently of each other hydrogen, alkyl or aryl;  
the substituents R<sup>3</sup> on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I.

3. The compound of formula I according to claim 1, wherein

R<sup>1</sup> and R<sup>2</sup> are the same and are aryl;  
R<sup>3</sup> is *tert.*-butyl or phenyl;  
R<sup>4'</sup> and R<sup>4</sup> are the same and are hydrogen;  
R<sup>5</sup> and R<sup>6</sup> are hydrogen; and the dotted line is absent.

4. The compound of formula I according to claim 1, wherein

R<sup>1</sup> and R<sup>2</sup> are the same and are alkyl;  
R<sup>3</sup> is *tert.*-butyl or phenyl;  
R<sup>4'</sup> and R<sup>4</sup> are the same and are hydrogen;  
R<sup>5</sup> and R<sup>6</sup> are hydrogen; and the dotted line is absent.

5. The compound of formula I according to claim 1, wherein

R<sup>1</sup> and R<sup>2</sup> are the same and are cycloalkyl;  
R<sup>3</sup> is *tert.*-butyl or phenyl;  
R<sup>4'</sup> and R<sup>4</sup> are the same and are hydrogen;  
R<sup>5</sup> and R<sup>6</sup> are hydrogen; and the dotted line is absent.

6. The compound of formula I according to claim 1, wherein

R<sup>1</sup> and R<sup>2</sup> are the same and are heteroaryl;  
R<sup>3</sup> is *tert.*-butyl or phenyl;  
R<sup>4'</sup> and R<sup>4</sup> are the same and are hydrogen;  
R<sup>5</sup> and R<sup>6</sup> are hydrogen; and the dotted line is absent.

7. The compound of formula I, wherein  $R^1$  and  $R^2$  are the same and are phenyl,  $R^3$  is phenyl and  $R^4$ ,  $R^{4'}$ ,  $R^5$  and  $R^6$  are hydrogen.

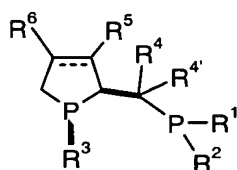
8. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis* I, wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^{8'}$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is an optional double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^{8'}$ ; and

$R^8$  and  $R^{8'}$  are independently of each other hydrogen, alkyl or aryl;

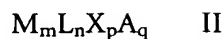
the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I;

X is a coordinating anion,

m, n and p are each 1, and

q is 0, if M is Rh.

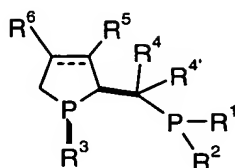
9. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis*

I, wherein

R<sup>1</sup> and R<sup>2</sup> are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl, -SO<sub>2</sub>-R<sup>7</sup>, -SO<sub>3</sub><sup>-</sup>, -CO-NR<sup>8</sup>R<sup>8'</sup>, carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

R<sup>3</sup> is alkyl, cycloalkyl, aryl or heteroaryl;

R<sup>4'</sup> and R<sup>4</sup> is independently of each other hydrogen, alkyl or optionally substituted aryl; or

R<sup>4'</sup> and R<sup>4</sup> together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is an optional double bond;

R<sup>5</sup> and R<sup>6</sup> are independently of each other hydrogen, alkyl or aryl;

R<sup>7</sup> is alkyl, aryl or NR<sup>8</sup>R<sup>8'</sup>; and

R<sup>8</sup> and R<sup>8'</sup> are independently of each other hydrogen, alkyl or aryl;

the substituents R<sup>3</sup> on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is acyloxy,

m and n are each 1,

p is 2, and

q is 0, if M is Ru.

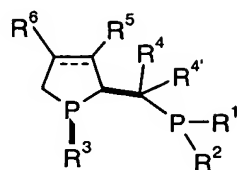
10. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis* I,

wherein

R<sup>1</sup> and R<sup>2</sup> are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl, -SO<sub>2</sub>-

R<sup>7</sup>, -SO<sub>3</sub><sup>-</sup>, -CO-NR<sup>8</sup>R<sup>8'</sup>, carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl,

dialkylarylsilyl or triarylsilyl;

R<sup>3</sup> is alkyl, cycloalkyl, aryl or heteroaryl;

R<sup>4'</sup> and R<sup>4</sup> is independently of each other hydrogen, alkyl or optionally substituted aryl; or

R<sup>4'</sup> and R<sup>4</sup> together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

R<sup>5</sup> and R<sup>6</sup> are independently of each other hydrogen, alkyl or aryl;

R<sup>7</sup> is alkyl, aryl or NR<sup>8</sup>R<sup>8'</sup>; and

R<sup>8</sup> and R<sup>8'</sup> are independently of each other hydrogen, alkyl or aryl;

the substituents R<sup>3</sup> on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is Cl,

m and n are each 2,

p is 4,

q is 1, and

A is triethylamine, if M is Ru.

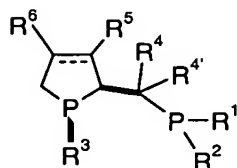
11. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis*

I, wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxy carbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^4$  and  $R^4'$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^4$  and  $R^4'$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

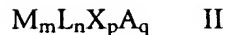
X is a  $\pi$ -metallyl group,

m and n are each 1,

p is 2, and

q is 0, if M is Ru.

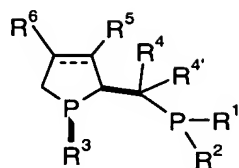
12. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis*

I, wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8'$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8'$ ; and

$R^8$  and  $R^8'$  are independently of each other hydrogen, alkyl or aryl;

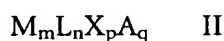
the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is a coordinating anion,

m, n and p are each 1, and

q is 0, if M is Ir.

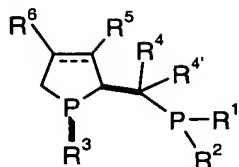
13. A transition metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of formula I



*cis* I, wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^4'$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^4'$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is Cl,

m and n are each 1,

p is 2, and

q is 0, if M is Pd.

14. A transition metal complex of formula II

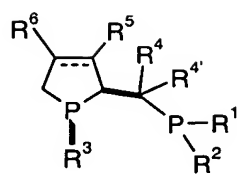


wherein

M is a transition metal,



L is the diphosphine compound of formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^4$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^4$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

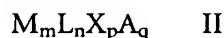
X is Cl, Br or I,

m and n are each 1,

p is 2, and

q is 0, if M is Ni.

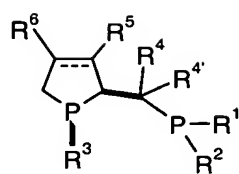
15. A transition metal complex of formula



wherein

M is Rh,

L is the diphosphine compound the formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^{8'}$  are independently of each other hydrogen, alkyl or aryl;

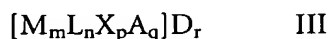
the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is a coordinating anion,

m, n and p are each 1, and

q is 0.

16. A metal complex of formula



wherein

M is a transition metal,

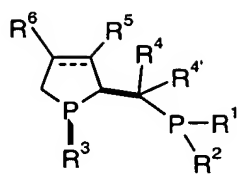
*cis*

q is 0, if M is Rh.

$$[M_m L_n X_p A_q] D_r \quad \text{III}$$

M is for a transition metal,

L is the diphosphine compound of formula I



*cis*

I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is an olefinic ligand,

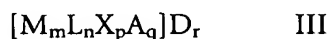
D is a non-coordinating anion,

m, n and r are each 1,

p is 2 and

q is 0, if M is Rh.

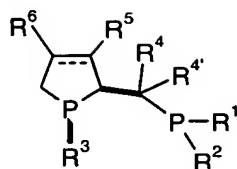
18. A metal complex of formula



wherein

M is a transition metal,

L is the diphosphine compound of the formula I



*cis* I, wherein

R¹ and R² are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl, -SO₂-R⁷, -SO₃⁻, -CO-NR⁸R⁸', carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

R³ is alkyl, cycloalkyl, aryl or heteroaryl;

R⁴' and R⁴ is independently of each other hydrogen, alkyl or optionally substituted aryl; or

R⁴' and R⁴ together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

R⁵ and R⁶ are independently of each other hydrogen, alkyl or aryl;

R⁷ is alkyl, aryl or NR⁸R⁸'; and

R⁸ and R⁸' are independently of each other hydrogen, alkyl or aryl;

the substituents R³ on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

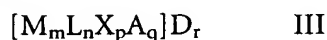
X is Cl, Br or I,

A is benzene or p-cymene,

D is Cl, Br or I, and

m, n, p, q and r are each 1, if M is Ru.

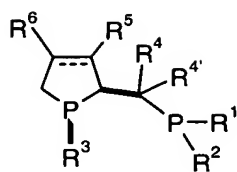
19. A metal complex of formula



wherein

M is for a transition metal,

L is for the diphosphine compound of formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

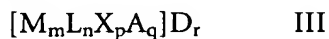
D is a non-coordinating anion,

m and n are each 1,

p and q are each 0, and

r is 2, if M is Ru.

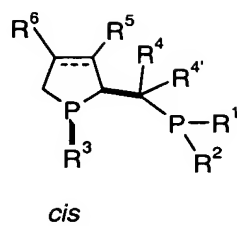
20. A metal complex of formula



wherein

M is for a transition metal,

L is for the diphosphine compound of the formula I



wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

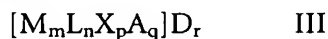
X is a diene ligand,,

D is a non-coordinating anion,

m, n, p and r are each 1, and

q is 0, if M is Ir.

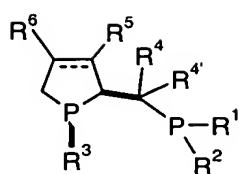
21. A metal complex of formula



wherein

M is for a transition metal,

L is the diphosphine compound of the formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is an olefinic ligand,

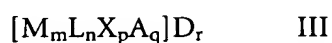
D is a non-coordinating anion,

m, p and r are each 1,

n is 2 and

q is 0, if M is Ir.

22. A metal complex of formula

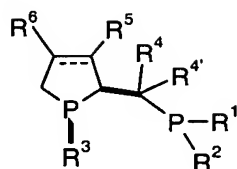


wherein



M is a transition metal,

L is the diphosphine compound of formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^4$  and  $R^4'$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^4$  and  $R^4'$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I.

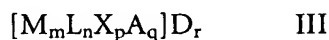
X is a  $\pi$ -allyl group,

D is a non-coordinating anion,

m, n, p and r are each 1, and

q is 0, if M is Pd.

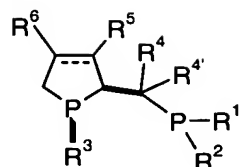
23. A metal complex of formula



wherein

M is for Rh,

L is for the diphosphine compound of the formula I



*cis* I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^4$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^4$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I, and

wherein

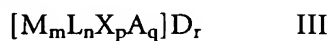
X is a diene ligand,

D is a non-coordinating anion,

m, n, p and r are each 1, and

q is 0.

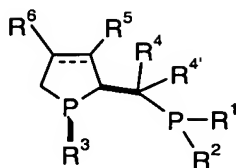
24. A metal complex of formula



wherein

M is for Rh,

L is for the diphosphine compound of the formula I



*cis*

I,

wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-SO_2-$ ,  $R^7$ ,  $-SO_3^-$ ,  $-CO-NR^8R^8$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl;

$R^7$  is alkyl, aryl or  $NR^8R^8$ ; and

$R^8$  and  $R^8$  are independently of each other hydrogen, alkyl or aryl;

the substituents  $R^3$  on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is an olefinic ligand,

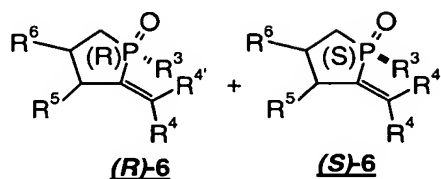
D is a non-coordinating anion,

m, n and r are each 1,

p is 2 and

q is 0.

25. An optical active compound of formula 6



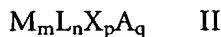
wherein  $R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

$R^{4'}$  and  $R^4$  together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is absent or is present and forms a double bond;

$R^5$  and  $R^6$  are independently of each other hydrogen, alkyl or aryl.

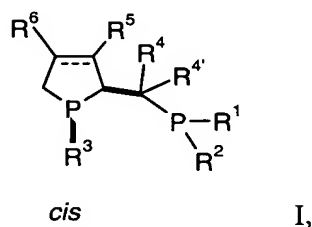
26. A process for the asymmetric hydrogenation of a prochiral olefinic or ketonic compound wherein the reaction is carried out in presence of metal complex of formula II



wherein

M is a transition metal,

L is the diphosphine compound of the formula I



wherein

$R^1$  and  $R^2$  are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl,  $-\text{SO}_2-$ ,  $-\text{SO}_3^-$ ,  $-\text{CO}-\text{NR}^8\text{R}^{8'}$ , carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

$R^3$  is alkyl, cycloalkyl, aryl or heteroaryl;

$R^{4'}$  and  $R^4$  is independently of each other hydrogen, alkyl or optionally substituted aryl; or

R<sup>4'</sup> and R<sup>4</sup> together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

R<sup>5</sup> and R<sup>6</sup> are independently of each other hydrogen, alkyl or aryl;

R<sup>7</sup> is alkyl, aryl or NR<sup>8</sup>R<sup>8'</sup>; and

R<sup>8</sup> and R<sup>8'</sup> are independently of each other hydrogen, alkyl or aryl;

the substituents R<sup>3</sup> on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is a coordinating anion,

m, n and p are each 1, and

q is 0, if M is Rh, or

wherein

M is a transition metal,

L is the diphosphine compound of formula I,

X is acyloxy,

m and n are each 1,

p is 2, and

q is 0, if M is Ru, or

wherein

M is a transition metal,

L is the diphosphine compound of formula I,

X is Cl,

m and n are each 2,

p is 4,

q is 1, and

A is triethylamine, if M is Ru, or

wherein

M is a transition metal,

L is the diphosphine compound of formula I,

X is a  $\pi$ -methallyl group,

m and n are each 1,  
p is 2, and  
q is 0, if M is Ru, or

wherein

M is a transition metal,  
L is the diphosphine compound of formula I,  
X is a coordinating anion,  
m, n and p are each 1, and  
q is 0, if M is Ir, or

wherein

M is a transition metal,  
L is the diphosphine compound of formula I,  
X is Cl,  
m and n are each 1,  
p is 2, and  
q is 0, if M is Pd, or

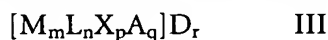
wherein

M is a transition metal,  
L is the diphosphine compound of formula I,  
X is Cl, Br or I,  
m and n are each 1,  
p is 2, and  
q is 0, if M is Ni, or

wherein

M is Rh,  
L is the diphosphine compound of formula I;  
X is a coordinating anion,  
m, n and p are each 1, and  
q is 0.

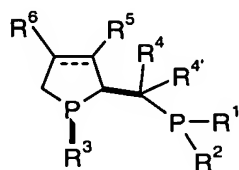
27. A process for the asymmetric hydrogenation of a prochiral olefinic or ketonic compound wherein the reaction is carried out in presence of metal complex of formula III



wherein

M is a transition metal,

L is the diphosphine compound of the formula I



*cis* I,

wherein

R<sup>1</sup> and R<sup>2</sup> are independently of each other unsubstituted alkyl, aryl, cycloalkyl or heteroaryl, or alkyl, aryl, cycloalkyl or heteroaryl each of which independently is substituted by alkyl, alkoxy, halogen, hydroxy, amino, mono- or dialkylamino, aryl, -SO<sub>2</sub>-R<sup>7</sup>, -SO<sub>3</sub><sup>-</sup>, -CO-NR<sup>8</sup>R<sup>8'</sup>, carboxy, alkoxycarbonyl, trialkylsilyl, diarylalkylsilyl, dialkylarylsilyl or triarylsilyl;

R<sup>3</sup> is alkyl, cycloalkyl, aryl or heteroaryl;

R<sup>4'</sup> and R<sup>4</sup> is independently of each other hydrogen, alkyl or optionally substituted aryl; or

R<sup>4'</sup> and R<sup>4</sup> together, with the C-atom they are attached, form a 3-8-membered carbocyclic ring;

dotted line is optionally a double bond;

R<sup>5</sup> and R<sup>6</sup> are independently of each other hydrogen, alkyl or aryl;

R<sup>7</sup> is alkyl, aryl or NR<sup>8</sup>R<sup>8'</sup>; and

R<sup>8</sup> and R<sup>8'</sup> are independently of each other hydrogen, alkyl or aryl;

the substituents R<sup>3</sup> on the phospholane phosphorus atom and the substituent on the C2 atom of the phospholane ring are in *cis* relation to each other as indicated by the bold bonds in formula I,

X is a diene ligand,

D is a non-coordinating anion,

m, n, p and r are each 1, and

q is 0, if M is Rh, or

wherein

M is for a transition metal,  
L is the diphosphine compound of formula I,  
X is an olefinic ligand,  
D is a non-coordinating anion,  
m, n and r are each 1,  
p is 2 and  
q is 0, if M is Rh, or

wherein

M is a transition metal,  
L is the diphosphine compound of formula I;  
X is Cl, Br or I,  
A is benzene or p-cymene,  
D is Cl, Br or I, and  
m, n, p, q and r are each 1, if M is Ru, or

wherein

M is for a transition metal,  
L is for the diphosphine compound of formula I,  
D is a non-coordinating anion,  
m and n are each 1,  
p and q are each 0, and  
r is 2, if M is Ru, or

wherein

M is for a transition metal,  
L is for the diphosphine compound of formula I,  
X is a diene ligand,,  
D is a non-coordinating anion,  
m, n, p and r are each 1, and  
q is 0, if M is Ir, or



wherein

M is for a transition metal,  
L is the diphosphine compound of formula I,  
X is an olefinic ligand,  
D is a non-coordinating anion,  
m, p and r are each 1,  
n is 2 and  
q is 0, if M is Ir, or

wherein

M is a transition metal,  
L is the diphosphine compound of formula I;  
X is a  $\pi$ -allyl group,  
D is a non-coordinating anion,  
m, n, p and r are each 1, and  
q is 0, if M is Pd, or

wherein

M is for Rh,  
L is for the diphosphine compound of formula I,  
X is a diene ligand,  
D is a non-coordinating anion,  
m, n, p and r are each 1, and  
q is 0, or

wherein

M is for Rh,  
L is for the diphosphine compound of formula I,  
X is an olefinic ligand,  
D is a non-coordinating anion,  
m, n and r are each 1,  
p is 2 and  
q is 0.